



Glucocorticoid Use in Dental Surgery

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Introduction

In 1949, Dr. Philip Hench discovered that high doses of cortisol produced favorable anti-inflammatory effects in his rheumatoid arthritis patients.¹ *Cortisol* is an endogenous glucocorticoid, a steroid produced by the adrenal cortices that regulates numerous vital processes, including control of inflammation, stress, metabolism, blood pressure, and sleep cycles. Since Dr. Hench's initial breakthrough, corticosteroid therapy has been expanded to a wide range of clinical applications. One such application is utilization in dental surgery to improve both patient-centered and therapeutic outcomes. This clinical update aims to provide an overview of the role of glucocorticoids in dentoalveolar surgery, discuss specific steroid drugs and regimens, and review the most up-to-date literature on the peri-operative use of these medications.

Basic Physiology of Inflammation

The inflammatory process is comprised of the vascular phase and the cellular phase. Biological triggering agents activate the vascular phase, leading to vasodilation and hyperemia. The dilation of arterioles and shrinkage of endothelial lining cells enhances vascular permeability and extravasation of plasma. Similarly, the cellular phase is initiated by chemotactic targeting of leukocytes in the blood, which draws them to the desired site and triggers diapedesis and emigration into the tissues.¹ These processes ultimately culminate in the clinical sequelae of redness, heat, swelling, and pain. While inflammation is essential for wound healing, excessive swelling can compromise surgical healing and increase the patient's pain experience. Steroid therapy can lessen these undesirable outcomes in cases where significant pain and swelling are anticipated.¹

Pharmacologic Effects of Glucocorticoids

Glucocorticoids bind to specific cytoplasmic receptors within the cell, forming a complex that migrates into the cell nucleus, binds to DNA, and causes changes in protein synthesis. Multiple cellular functions are consequently modified. Glucocorticoids induce *annexin*, a protein that inhibits phospholipase A2, the rate-limiting step of the arachidonic acid cascade. This dampening effect thwarts the downstream expression of pain and inflammatory mediators, including prostaglandins, prostacyclins, thromboxanes, and leukotrienes.^{1,2} Additional anti-inflammatory effects include the decreased formation of vasodilatory bradykinin, decreased lysozyme release, and decreased capillary permeability, thus preventing diapedesis and plasma protein leakage into the tissue space.^{3,4,5}

Peri-Operative Use of Glucocorticoids

Glucocorticoid therapy is well documented in the oral surgery literature. While most studies focus on glucocorticoid use for third molar extractions, the findings can be applied to other dentoalveolar surgical procedures. The outcomes generally show favorable results in reducing pain, swelling, and trismus when using corticosteroids; however, effectiveness varies between glucocorticoid type, administration route, and delivery timing (Table 1). A 2013 systematic review of 28 articles found that corticosteroid use for third molar extractions improved patients' post-operative experience. However, an intravenous route and pre-operative delivery observed the most significant effects.⁶ More evidence supporting the pre-operative approach was echoed in a 2022 systematic review that reported little justification for oral post-operative corticosteroid regimens.⁷ An additional effect of steroid therapy is a reduction of post-operative nausea and vomiting (PONV) potentially associated with sedation.¹

Drugs, Dosages, and Routes of Administration

Dexamethasone (dex) is one of the most widely researched corticosteroids. It can be administered via five routes, including oral, intravenous (IV), intramuscular, submucosal, and endoalveolar methods. When comparing a 4mg dose given by each route immediately after third molar extraction, swelling, pain, and trismus were reduced for all approaches, but superior swelling reduction was noted for IV delivery.⁸ A third molar extraction study from 2015 compared pre-operative dex doses of 4mg IV and 8mg orally, reporting a similar reduction in post-operative pain, swelling, and trismus between groups.⁹ Additionally, a 2022 study comparing 8mg IV dex to a placebo given prior to periodontal flap surgery showed a significant reduction in pain and swelling during the first week of healing for the dex group.¹⁰ Not surprisingly, the shared consensus among oral surgery and periodontal community researchers agrees with the anesthesiology literature. A systematic review and meta-analysis confirmed that dex use at doses of more than 0.1mg/kg during general anesthesia cases reduced post-operative pain and opioid consumption for various medical surgeries.¹¹ Similarly, a 2022 meta-analysis found strong evidence of reduced swelling, vomiting, post-operative pain, and opioid usage with peri-operative IV dex use in total joint arthroplasty.¹² It should be noted that rapid delivery of IV dex can cause genital or perineal burning or itching, which can be minimized through gradual infusion.¹³

Betamethasone, a glucocorticoid of equivalent potency to dexamethasone, has shown mixed results in the literature. A 2014 study evaluating post-operative submucosal injection with 12mg of betamethasone showed no improvement in post-

operative swelling, pain, or trismus following tooth extraction.¹⁴ In contrast, 0.5mg betamethasone taken orally three times a day following third molar surgery showed favorable results.¹⁵

Prednisolone and *methylprednisolone* have also been evaluated in third molar extraction studies, showing efficacy in reducing swelling, trismus, and, to a lesser extent, post-operative pain when prescribed orally at a dose of 40mg or more.³ Methylprednisolone is commercially available in tapered-dose packaging for a convenient prescribing option.⁷ For maximum efficacy, oral glucocorticoid doses should be initiated at least 2 to 4 hours before the surgical procedure.¹⁶

Table 1: Dose Equivalencies Chart (adapted from Lexicomp)¹⁷

Glucocorticoid	Approximate Equivalent Dose (mg)	Relative Anti-inflammatory Potency	Duration of Action (Hours)
Hydrocortisone (Cortisol)	20	1	8 to 12
Dexamethasone	0.75	25 to 30	36 to 72
Betamethasone	0.6 to 0.75	25	36 to 72
Methylprednisolone	4	5	12 to 36
Prednisolone	5	4	12 to 36

Complications and Considerations

Contraindications for glucocorticoid therapy include uncontrolled diabetes, immunocompromised status, osteoporosis, and active herpetic outbreaks or fungal infections.¹ Additionally, caution should be taken to avoid high doses in patients with psychosis or other affective disorders, as the literature shows an association between glucocorticoid usage and adverse neuropsychiatric events.¹⁸ Short-term use of glucocorticoids, as typically prescribed in the dental surgery setting, is generally safe. Rare side effects include euphoria, depression, irritability, anger, insomnia, and increased appetite, and may be more commonly seen at higher, long-term dosing.¹⁹ Of note, long-term use of glucocorticoids for other systemic conditions may disqualify a patient for elective dental surgery. Such patients have an increased risk for infection and impaired healing. Specifically impacting elective periodontal and dental implant surgeries, soft tissue healing may be delayed along with the possible inhibition of bone-forming cells, leading to an increased risk for necrosis of bone.¹

Conclusion

Glucocorticoids can be an effective therapy when utilized by experienced providers in surgical procedures expected to elicit heightened pain and swelling. The multidisciplinary literature consensus supports that intravenous dexamethasone given pre-operatively in the range of 4-10mg effectively reduces pain and swelling, with the added advantage of curtailing PONV risk inherent in IV sedation. Alternatively, oral dexamethasone or methylprednisolone can be prescribed in an equivalent dosage (Table 1). However, the clinician must plan to allow oral regimens to be initiated 2 to 4 hours before the procedure. Finally, providers must thoroughly investigate and understand the patient's medical history to properly weigh the risk and benefits of glucocorticoid use.

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